Air Force Research Laboratory|AFRL

Science and Technology for Tomorrow's Air and Space Force

Success Story

ACTIVE FLOW CONTROL ENABLES SAFE SUPERSONIC WEAPONS RELEASE

Future generations of strike aircraft will almost certainly require the ability to release weapons at high supersonic and/or hypersonic speeds. This requirement demands the development of technology that will help stabilize the release of stores at these high-speed regimes. Through its groundbreaking experimental efforts, the Long Range Strike Aero Experiment (LRSAe) has taken a huge step in proving the viability of active flow control as a solution to this problem.

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Accomplishment

The Air Vehicles Directorate, in cooperation with Boeing Phantom Works, successfully demonstrated the safe supersonic release of 10%-scale, 500-lb Joint Direct Attack Munition (JDAM) models from a rectangular bay using active flow control technology. The directorate conducted free-drop tests at Boeing's Polysonic Wind Tunnel in St. Louis, Missouri.

Through these experiments, LRSAe established a clear improvement of separation characteristics when they applied active flow control (AFC). The JDAM models in the baseline drops invariably changed direction immediately after leaving the bay, subsequently striking the bay while the runs with AFC consistently provided safe separation over a range of Mach numbers.

Background

At supersonic flight conditions, the dynamic and unpredictable environment around the aircraft includes strong, unsteady shock systems and expansion fans—features which are not present at lower velocities. This is in addition to the turbulent shear layers, boundary layers, and separated flow that influence store separation at all flight regimes. These forces may alter the trajectory of the store towards the aircraft and cause a potential hazard to both the store and the releasing aircraft.

LRSAe's purpose is to develop flow control technologies that will eventually overcome the technical challenges associated with weapons integration on a supersonic platform. It has included several types of wind tunnel experiments using a 10%-scale weapons bay model and scaled Mk-82 JDAM models.

The directorate performed testing to demonstrate significant acoustic reductions achieved using several kinds of AFC devices. Grid survey testing showed significant differences between the baseline and AFC cases in the pitching moments applied to the store outside the bay.

Directorate researchers validated the results of this grid testing by a free-drop experiment where high-speed video captured the behavior of 12 stores released into the supersonic flow. The success of this wind tunnel entry prompted the addition of another test in which 40 weapon models were released. The combined results of all this experimentation show AFC as undeniably effective technology for enabling supersonic weapons integration efforts.

Air Vehicles
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Additional information

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